Information Sheet:
Disabilities and Diversity in Science and Engineering

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Introduction

Today, more students with disabilities are in the educational pipeline than ever before, as a result of special education, legally mandated services, and structural accommodations (McGuire & Scott, 2006). If the United States is to have effective and productive learning environments in higher education, updating the nation's understanding of disability and its implications and updating educational practices are critical.

Why Inclusion Is Important

The United States is a leader in accommodation, rehabilitation, and assistive technologies, but the design of assistive technologies is better with the input, insight, and leadership of the people for whom it is being created (Seelman, 2001). Researchers with disabilities should be included in the cycles of discovery, innovation, and technology development generally. Educational environments are better when diverse students learn together (American Educational Research Association, Association of American Colleges and Universities, & American Association for Higher Education, 2003). Inclusion of students with disabilities in science and engineering is a national goal (National Science Foundation, Committee on Equal Opportunities in Science and Engineering [CEOSE], 2009). The rate of participation could be higher.

Demographics

About 11% of undergraduate students in science and engineering fields have one or more disabilities, and that percentage is parallel with the number of persons with disabilities ages of ages 15 through 24 in the general population. Among the latter group (all people ages 15 through 24), more than one half (of the 11%) have learning disabilities (CEOSE, 2009, p. 30).

About 7% of graduate students in science and engineering were persons with disabilities in 2004, the latest year available (CEOSE, 2009, p. 9). Only 1% of people holding doctorates in science and engineering reported having disabilities (CEOSE, 2009, p. 30). The number of STEM doctorates awarded annually to persons with disabilities is low (about 1.7% in 2005), and the absolute number declined between 1998 and 2005 (CEOSE, 2009, p. 9).

The number of faculty with disabilities in science and engineering fields is low overall (about 19,700 of 249,700 faculty or 7.9% in 2008; National Science Foundation, Division of Science Resources Studies [NSF, SRS], 2011, Table 9-28).

In the general population not specifically in science and engineering fields in 2009, 10.1% of adults between the ages of 18 and 64 were disabled (Rehabilitation Research and Training Center on Disability Statistics and Demographics, 2010).

Trends in Special Education

The Individuals with Disabilities Act (IDEA) of 2004 requires U.S. public schools to offer free and appropriate education to children with disabilities, and its regulations guide the provision of special education services (http://idea.ed.gov). About 13% of students enrolled in public schools in 2007–2008 received special education services (Aud et al., 2010). Of those, 39% received services because of learning disabilities and 22% because of speech or language impairments.

A New Climate and Environment for Disability

The revolution in special education is part of significant recent changes in the treatment of people with disabilities in the United States. During a few decades starting in the early 1970s, a great transformation occurred. The Vocational Rehabilitation Act of 1973 and other laws in the same decade boosted the transformation in conditions and opportunities (Scotch, 2001). The phrase "reasonable accommodation"—changes in physical environments and changes in U.S. actions to improve access—became part of the public discourse. Now the infrastructure for information, advocacy, social and medical support, employment, and research is well established.

Universities began to install programs to support students with disabilities in 1948 (Brown, 2008). Disability services in higher education evolved and expanded in the 1980s and 1990s, following the Education for All Handicapped Children Act (1975) and the Americans with Disabilities Act (1990) (McGuire & Scott, 2006).

Changing Practices (Universal Design for Instruction)

McGuire and Scott introduced universal design for instruction (UDI) in 1998 following focus groups with college faculty and incorporating research on approaches to college instruction. The American Association for Higher Education applied pressure to universities to improve access (McGuire & Scott, 2006; Scott, McGuire, & Embry, 2002). UDI starts with principles and then integrates them into the design of courses and interactions in the classroom (Scott, McGuire, & Shaw, 2003). A number of centers and websites serve faculty, especially junior faculty and graduate teaching assistants, as they seek to assimilate and incorporate UDI principles, including the University of Connecticut's Center on Postsecondary Education and Disability (http://www.facultyware.uconn.edu), the Association on Higher Education and Disability (AHEAD. http://www.ahead.org), CAST (http://www.cast.org), and the University of Washington's DO-IT project (http://www.washington.edu/doit/Faculty/). Some centers specialize in the application of UDI in science, computer science, and mathematics, including SciTrain, at the Center for Assistive Technology and Environmental Access (CATEA) at the Georgia Institute of Technology (http://catea.gatech.edu/scitrain).

Comprehensive Campus-based Services

Significant financial support for the recruitment and support of students with disabilities in science and engineering fields comes from the NSF Research in Disabilities Education program, which funds regional alliances that integrate a comprehensive range of services. One example is the Midwestern Alliance in Science, Technology, Engineering & Mathematics (MidwEST, http://stemmidwest.org), a consortium of educators, scientists and disabled-student service providers. The alliance provides assistive tools for students, such as remote captioning, equation translation with Braille code, individualized strategy instruction for students with learning disabilities, and services management for students with severe physical disabilities. MidwEST programs also include student stipends and a wide range of technical assistance to faculty and administrators. This alliance expects to affect 406,000 students with disabilities,

1,692 school districts, 3,374 public and private middle and high schools, and 221 institutions of higher education in Wisconsin, Illinois and Iowa.

Research on Methods to Broaden Access to Science and Engineering Courses

The population called "students with disabilities" encompasses great demographic variation on the basis of type of disability alone. Research on the experience of students with disabilities is challenged by the difficulty of finding adequate-sized research samples and defining and finding control groups. Scarcity of research funding further limits the amount of quality research conducted. Few generalized survey and assessment tools exist, and their evolution requires a wide base of experience and special investment in cross-project evaluation methods.

In addition to alliances (providing comprehensive, campus-based services) and experimental, short-term intervention programs such as internships or summer camps, NSF funds exploration in pedagogical strategies and curriculum that promise greater access and effectiveness for students with disabilities (see, for example, NSF, 2009a, 2009b, 2010a, 2010b, & 2011). For example, SciTrain conducts research on methods to train high school math and science teachers to be more effective instructors for students with disabilities ((http://catea.gatech.edu/scitrain). In parallel, SciTrain U provides tools for postsecondary educators to implement UDI principles in college classrooms (http://www.catea.gatech.edu/scitrainU/login.php). It offers tutorials designed to answer many of the questions raised by instructors who have never taught a student with a disability. It also offers a course called "Improved Teaching for Large Lecture Classes" that is not specific to science and engineering content.

Research on Methods Targeting Minority and Female Students with Disabilities

A number of experimental programs explore how to encourage and support disabled girls and minority students who are pursuing science and technology careers. WAMC Northeast Public Radio (http://www.womeninscience.org) captured profiles of several outstanding examples, including Space Camp for Interested Visually Impaired Students (http://www.tsbvi.edu/space), the American Association for the Advancement of Science's Entry Point (http://ehrweb.aaas.org/entrypoint), the Rochester Institute of Technology's TechGirlz (http://www.rit.edu/ntid/techgirlz), MIND Alliance (http://www.mystem.org), and the University of Washington's DO-IT Project.

Role Models

Nearly 20,000 faculty with disabilities worked in science and engineering fields in 2008 (NSF, SRS, 2011, Table 9-28). Some well-known scientists and inventors allegedly had disabilities that were hidden or undiagnosed (Disabled World, 2006). Some notable scientists with disabilities include Stephen Hawking, Robert Murphy, Albert Einstein, and Alfred Nobel. Contemporary scientists and engineers have become more visible (*Report from the Workshop on Excellence . . .*, 2009; American Association for the Advancement of Science, 2010).

Areas for Future Research

The field of disability studies emerged in the late 20th century (Whyte & Ingstad, 1995; Albrecht, Seelman, & Bury, 2011). The Society for Disability Studies was founded in 1982 and started publishing the *Disability Studies Quarterly* in 1986 ((http://www.disstudies.org/about/history).

Research specializing in educational access in science and engineering fields is even more scarce and recent. The database of awards made by the NSF Research on Disability in Education program

(http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5482&org=HRD&from=home) shows 182 grants since 1992, of which only a fraction are strictly educational or social science research yielding academic peer-reviewed publications (as opposed to alliances or centers providing comprehensive services, educational demonstration programs, or conferences and workshops)(http://www.nsf.gov/awardsearch). The matrix of possibilities for research on educational access in science and engineering fields is quite large. Gross parameters defining the scope of study include disability type, educational level, gender, race/ethnicity, socioeconomic status, field and content areas within science and engineering, application of assistive technology tools, application of principles of UDI, and social supports.

Any emerging field of research needs a frequent review of findings, synthetic reviews, and identification of new research questions that arise.

A knowledge database of 147 articles on disability and accommodations in science and mathematics will be posted in 2011 on the SciTrain database ((http://www.catea.gatech.edu/scitrain/kb/index.php).

Recommendations/Future Needs

1. More research on the effectiveness of particular assistive technologies
2. More research on the effectiveness of particular UDI applications
3. A database, catalog, or summary of research projects focused on science and engineering education and access for students with disabilities, by detailed classification
4. Synthetic reviews of findings to date and identification of new research questions
5. Wide dissemination of research bibliographies that have been compiled, for example, the SciTrain annotated bibliography
6. Wide dissemination and "translation" of promising practices

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